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# Risk Factors and Maternal and Neonatal Outcomes of Pregnant Women with Total Labor over 24 Hours

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**【Abstract】 Background** It is of great importance to standardize labor management for ensuring maternal and neonatal safety. Since the publication of the new stage of labor, the definition of prolonged labor has not been emphasized and it is recommended to minimize interventions during labor, therefore, the number of pregnant women with labor over 24 h is increased compared to the previous. **Objective** To analyze the risk factors and maternal and neonatal outcomes of pregnant women with labor over 24 h and discuss the labor management under the new stage of labor. **Methods** The clinical data of pregnant women received maternity examination and delivered at Department of Obstetrics, the First Affiliated Hospital with Nanjing Medical University from January to December 2022 were collected in the retrospective study. A total of 40 single birth pregnant women with normal fetal position and prolonged total labor (more than 24 h) were selected as the observational group, and 95 single birth pregnant women with normal fetal position and normal total labor (less than 24 h) were selected as the control group. The age, BMI, gestational age of delivery, gestational diabetes, gestational hypertension, neonatal body mass, labor condition, analgesic delivery rate and delivery intervention rate of the two groups were compared. Multivariate Logistic regression analysis was used to explore the risk factors for total labor over 24 h. The maternal and neonatal outcomes including intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration, postpartum hemorrhage, manual removal of placenta, fetal distress, neonatal asphyxia and referral to neonatal intensive care unit (NICU) were compared to screen the risk factors and analyse the maternal and neonatal outcomes of pregnant women with labor over 24 h. **Results** There were no significant differences in age, BMI, gestational age of delivery, gestational hypertension, gestational diabetes mellitus and neonate body mass between the two groups ( $P>0.05$ ). The first stage of labor, second stage of labor and total labor were longer and the rates of labor analgesia and labor intervention were higher in the observational group than the control group ( $P<0.05$ ). Multivariate Logistic regression analysis showed that labor analgesia and intervention were not risk factor for total labor over 24 h ( $P>0.05$ ). There were no significant differences in the incidence of postpartum

hemorrhage, vaginal instrumental delivery and fetal distress between the two groups ( $P>0.05$ ) ; the incidence of intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration and referral to NICU in the observational group was higher than the control group ( $P<0.05$ ) ; no neonatal asphyxia occurred in both groups. **Conclusion** The rates of labor analgesia and labor intervention were significantly increased in pregnant women with total labor over 24 h due to prolonged labor. Although prolonged labor does not increase the incidence of postpartum hemorrhage, manual removal of placenta and neonatal asphyxia, it increases the incidence of intrapartum fever, amniotic fluid contamination, mediolateral episiotomy, vaginal instrumental delivery, cervical laceration and fetal distress. Obstetricians and gynecologists should pay attention to the adverse maternal and neonatal outcomes caused by prolonged labor and individualized management of labor.

**【Key words】** Parturition; Obstetric labor; Pregnancy outcome; Fetal distress; Management of labor stage; Labor analgesia; Labor intervention; Risk factors

The total labor process is the whole process of labor, which refers to the process from the beginning of regular contractions to the delivery of the fetus and placenta, and it can be divided into three parts: the first stage of labor, also known as the period of dilatation of the cervix, the second stage of labor, also known as the period of fetal delivery, and the third stage of labor, also known as the period of delivery of the placenta. The management of the labor process is crucial to ensure the safety of mothers and infants, and standardized and individualized management of the labor process is the main way to improve the outcome of mothers and infants. In China, the early model of labor management was proposed by FRIEDMAN in 1954<sup>[1]</sup>, which was widely recognized in the world, but in recent years, clinical practice has found that due to the increase in the age of pregnant women in labor, the reduction of physical labor, and the wide application of labor analgesia, the previous model of labor management is no longer suitable for clinical practice. 2014, the Obstetrics and Gynecology Group of the Obstetrics and Gynecology Section of the Chinese Medical Association (CMA) made a comprehensive review of domestic and international literature, and made reference to the American national and international standards for the management of labor, referring to the relevant guidelines and expert consensus proposed by the National Institute of Child Health and Human Development (NICHD), the American College of Obstetricians and Gynecologists (ACOG), and the American Society for Maternal-Fetal Medicine (SMFM), etc.<sup>[2-3]</sup>, issued the "Expert Consensus on the Standard of the New Distance of Labor and its Management (2014)"<sup>[4]</sup>, in order to guide clinical practice in the management of the distance of labor in China. It was previously believed that a total labor duration of  $>24$  h could be diagnosed as

stagnant labor, which would lead to an adverse pregnancy outcome, but the definition of stagnant labor was not emphasized in the Expert Consensus on the Criteria and Management of the New Course of Labor (2014). The neo-labor model, which calls for minimizing interventions in labor, has greatly relaxed the time frame of labor, so the number of women with a total labor duration >24 h has increased compared to the previous period. In this study, we analyzed the number of women with a total duration of labor >24 h, and assessed the risk factors for prolonged total duration of labor and maternal and infant outcomes, with the aim of providing better guidance for clinical work, individualized management of the labor process, and reduction of the incidence of adverse outcomes for mothers and infants.

## 1 Data and Methods

**1.1 Subjects** A total of 135 women who underwent regular obstetric examination and delivered successfully in the Obstetrics Department of the First Affiliated Hospital of Nanjing Medical University in 2022 were retrospectively selected for the study. According to whether the total duration of labor was >24 h, the women were divided into the observation group (total duration of labor >24 h, 40 cases) and control group (total duration of labor ≤24 h, 95 cases). Inclusion criteria: (1) singleton pregnancy; (2) full-term delivery; (3) primigravida; (4) management of labor according to the "Expert Consensus on New Labor Criteria and Management (2014)". Exclusion criteria: delivery by cesarean section. The study was approved by the Ethics Committee of the First Affiliated Hospital of Nanjing Medical University (Luncheon Review No. 2023-SR-362), and all patients gave informed consent.

**1.2 Research Methods** The clinical data of the mothers were collected and recorded, and the relevant indicators of the control group and the observation group were analyzed and compared.

**1.2.1 General information** Age, BMI, gestational week of delivery, gestational hypertension, gestational diabetes mellitus, newborn body mass.

**1.2.2 Labor situation** Length of the first stage of labor, length of the second stage of labor, length of the third stage of labor, length of the total labor, whether labor analgesia, whether labor intervention (including: diazepam intravenous injection, pethidine intramuscular injection, resorcinol, oxytocin to strengthen contractions, artificial rupture of membranes).

**1.2.3 Maternal and infant outcomes** Whether fever during labor, amniotic fluid contamination, perineal circumcision, vaginal assisted delivery, cervical laceration, postpartum hemorrhage, artificial detachment of the placenta, fetal distress, neonatal asphyxia, and neonatal transfer to neonatal intensive care unit (NICU).

**1.3 Statistical methods** SPSS 23.0 software was used for statistical analysis. Measurement data were tested for

normality, and those conforming to normal distribution were expressed as  $(\bar{x} \pm s)$ , and the comparison between two groups was performed by the independent sample t-test; non-normally distributed measurements were expressed as  $M(P_{25}, P_{75})$ , and the comparison between two groups was performed by the rank-sum test; counting data were expressed as the relative number, and the comparison between two groups was performed by the  $\chi^2$  test. Multifactorial logistic regression analysis was used to investigate the factors affecting the total duration of labor  $>24$  h. The difference between the two groups was considered as  $P < 0.05$ . The difference was considered statistically significant at  $P < 0.05$ .

## 2 Results

**2.1 General conditions** Comparison of maternal age, BMI, gestational week of delivery, gestational hypertension, gestational diabetes mellitus and neonatal body mass in the two groups, the differences were not statistically significant ( $P > 0.05$ ), as shown in table 1.

**Table 1** Comparison of general data of maternal and infant in the two groups

Group	Cases	Age ( $\bar{x} \pm s$ , year)	BMI ( $\bar{x} \pm s$ , kg/m <sup>2</sup> )	Gestational week of delivery ( $\bar{x} \pm s$ , week)	Gestational hypertension [cases (%)]	Gestational diabetes mellitus [cases (%)]	Neonatal body mass ( $\bar{x} \pm s$ , kg)
Control group	95	28.9 $\pm$ 3.0	26.3 $\pm$ 2.9	39.7 $\pm$ 1.0	5 (5.3)	11 (11.6)	3.45 $\pm$ 0.26
Observational group	40	29.1 $\pm$ 3.2	27.3 $\pm$ 2.5	40.0 $\pm$ 1.1	5 (12.5)	4 (10.0)	3.55 $\pm$ 0.34
$t(\chi^2)$ value		0.240	1.951	1.814	1.224 <sup>a</sup>	0.001 <sup>a</sup>	1.869
$P$ value		0.811	0.053	0.072	0.269	0.973	0.064

Note: <sup>a</sup> indicates  $\chi^2$  value

**2.2 Delivery conditions** Comparison of the length of the third stage of labor between the two groups showed that the difference is not statistically significant ( $P > 0.05$ ); the length of the first stage of labor, the second stage of labor, and the total duration of labor of the observation group is longer than that of the control group, and the rate of labor analgesia and the rate of labor interventions is higher than that of the control group, and the difference is statistically significant ( $P < 0.05$ ), as shown in table 2.

**Table 2** Comparison of labor conditions between the two groups

Group	Cases	Duration of labor [ $M ( P_{25}, P_{75} )$ , h ]				Labor analgesia [cases ( % ) ]	Labor and delivery intervention [cases ( % ) ]
		First stage of labor	Second stage of labor	Third stage of labor	Total stage of labor		
Control group	95	10.00 ( 7.50, 13.20 )	1.00 ( 0.63, 1.52 )	0.10 ( 0.07, 0.15 )	11.40 ( 8.20, 14.30 )	79 ( 83.2 )	51 ( 53.7 )
Observational group	40	24.00 ( 22.50, 25.70 )	1.80 ( 0.98, 2.42 )	0.10 ( 0.08, 0.16 )	25.80 ( 24.60, 27.20 )	39 ( 97.5 )	40 ( 100.0 )
Z ( $\chi^2$ ) value		-9.154	-4.737	-0.752	-9.156	5.260 <sup>a</sup>	27.480 <sup>a</sup>
P value		<0.001	<0.001	0.452	<0.001	0.020	<0.001

Note: <sup>a</sup> indicates  $\chi^2$  value

**2.3 Multifactorial Logistic Regression Analysis of Factors Influencing the Total Labor Duration of >24 h** A multifactorial logistic regression analysis was performed using whether the total duration of labor was >24 h as the dependent variable (assigned value: total duration of labor >24 h=1, total duration of labor ≤24 h=0), and BMI (assigned value: measured value), gestational week of delivery (assigned value: measured value), neonatal body mass (assigned value: measured value), and analgesia for labor (assigned value: no = 0, yes = 1), which are the clinical high-risk indicators with  $P < 0.1$  in Tables 1 and 2, as the independent variables. The results showed that none of the above indicators was an influencing factor for the total duration of labor >24 h ( $P > 0.05$ ), as shown in table 3.

**Table 3** Multivariate Logistic regression analysis of influencing factors of labor over 24 hours

Variables	<i>B</i>	<i>SE</i>	Wald $\chi^2$ 值	<i>P</i> value	<i>CI</i> ( 95% )
BMI	0.136	0.076	3.218	0.073	1.146 ( 0.987, 1.330 )
Gestational week of delivery	0.373	0.220	2.872	0.090	1.453 ( 0.943, 2.237 )
Neonatal body mass	0.001	0.001	3.657	0.056	1.001 ( 1.000, 1.003 )
Labor analgesia	1.476	1.072	1.894	0.169	4.376 ( 0.535, 35.800 )

**2.4 Maternal and Infant Outcomes** There was no statistically significant difference in the incidence of postpartum hemorrhage, manual abruption of placenta and neonatal asphyxia between the two groups ( $P>0.05$ ); the incidence of postpartum fever, contaminated amniotic fluid, perineal excision, vaginal assisted delivery, cervical laceration and fetal distress, and transfer of newborns to the NICU in the observation group were higher than those in the control group, and the difference was statistically significant ( $P<0.05$ ), as shown in table 4. In the observation group, 9 cases of neonates were transferred to NICU: 4 cases of neonates with low oxygen saturation, 5 cases of neonates with shortness of breath, and all of them had good prognosis.

**Table 4** Comparison of maternal and fetal outcomes between the two groups

Group	Cases	Fever during labor	Amniotic fluid contamination	Lateral perineal incision	Assisted Vaginal Labor	Cervical laceration	Postpartum hemorrhage	Artificial abruption of placenta	Fetal distress	Neonatal asphyxia	Neonatal transfer to NICU
Control group	95	11 (11.6)	13 (13.7)	9 (9.5)	1 (1.1)	1 (1.1)	14 (14.7)	4 (4.2)	3 (3.2)	0	2 (2.1)
Observational group	40	19 (47.5)	12 (30.0)	20 (50.0)	5 (12.5)	5 (12.5)	7 (17.5)	4 (10.0)	7 (17.5)	0	9 (22.5)
$Z(\chi^2)$ value		21.014	4.966	27.409	6.199	6.199	0.164	0.813	6.480		13.037
$P$ value		<0.001	0.026	<0.001	0.013	0.013	0.686	0.367	0.011		<0.001

### 3 Discussion

In 2014, the Obstetrics and Gynecology Group of the Obstetrics and Gynecology Section of the Chinese Medical Association issued guidelines in which it de-emphasized the definition of staghorn labor and advocated minimizing interventions in the labor process when the conditions of the mother and baby permit, leading to an increase in the number of mothers with a total duration of labor  $>24$  h compared with the previous period. Although the definition of staghorn labor is no longer emphasized, prolonged labor may still lead to the occurrence of adverse maternal and infant outcomes. In order to assess the impact of prolonged labor on maternal and infant outcomes, the present study analyzed the influencing factors and maternal and infant outcomes of women with a total duration of labor of  $>24$  h, in order to further standardize and guide the management of labor.

This study analyzed and compared the general conditions of mothers and newborns in the control group and the observation group, including maternal age, BMI, gestational week of delivery, gestational hypertension, gestational diabetes mellitus, and newborn's body mass, and found that there was no statistically significant difference between the two groups, and the logistic regression analysis suggested that these factors were not the high-risk factors for prolonged total delivery duration of  $>24$  h. KHALIFA et al<sup>[5]</sup> compared 174 women with normal BMI and 164 women with high BMI and found that in women with high BMI and successful vaginal delivery, the birth mass of the newborn was significantly increased, the first and second stage of labor were significantly prolonged, resulting in an increased risk of chorioamnionitis, cervical laceration, incisional infections, and a higher rate of transfer of the newborn to the NICU. The results of the present study were not the same as those of the study by Shen Nan et al<sup>[6]</sup>, which showed that there was no statistically significant difference in maternal age, gestational week of delivery, BMI, gestational diabetes mellitus, gestational hypertension, preterm rupture of membranes, and whether labor was induced between the groups with a total duration of  $>24$  h and those with a total duration of  $\leq 24$  h. The results of the present study were not statistically significant as those of the present study. were not statistically significant, and the results of the present study were consistent with them.

Previous studies have shown that although labor analgesia greatly relieves the pain of pregnant women, it significantly increases the incidence of prolongation of the second stage of labor, which leads to a series of adverse outcomes for mothers and infants, such as chorioamnionitis, cervical laceration, postpartum hemorrhage, and so on, and the incidence of neonatal transfers to the NICU rises, and the incidence of short-term adverse neonatal outcomes is high<sup>[7-10]</sup>. The study of Shen Nan et al<sup>[6]</sup> has fully confirmed that labor analgesia is a risk factor for a total labor duration of  $>24$  h. In this study, although the observation of labor analgesia was not a significant factor, it was not a significant risk factor for a total labor duration of  $>24$  h. The possibility of selection bias due to the small sample size in this study needs to be further explored. The management of labor after labor analgesia, especially the second stage of labor, should still be given high priority in clinical practice. In addition, the results of this study showed that the rate of labor intervention in the observation group was significantly higher than that in the control group, considering that in the actual management of labor, in order to reduce the potential risk of prolonged labor to the mother and baby, doctors and midwives often take active interventions, which is in line with the results of previous studies<sup>[6]</sup>.

This study investigated the perinatal outcomes of primiparous women with a total labor duration  $>24$  h. The results of this study showed that there was no statistically significant difference in the incidence of postpartum



hemorrhage and manual abruption of the placenta between the two groups ( $P>0.05$ ) ; the incidence of postpartum fever, contamination of amniotic fluid, perineal excision, vaginal assisted delivery, and cervical laceration in the observation group was higher than that in the control group ( $P<0.05$ ). When abnormalities occur, active intervention should be carried out, and the rate of labor intervention, vaginal assisted delivery, and perineal circumcision often increase, which is consistent with the results of the study by MATTA et al [11]. In 2016, the study by Yan Sisi et al [12] showed that prolongation of labor did not increase the incidence of postpartum hemorrhage. Similarly, the results of the present study suggested that there was no significant difference in the incidence of postpartum hemorrhage and manual abruption of placenta. It may be due to the fact that prolongation of labor and prophylactic use of procoagulant drugs immediately after delivery of the fetus greatly reduced the incidence of postpartum hemorrhage and artificially abruption placenta. It has also been found that none of the postpartum complication rates of women with a total duration of labor  $>24$  h were significantly altered under the new mode of labor [13]. The results of this study showed that no neonatal asphyxia occurred in both groups, and the incidence of fetal distress and transfer to NICU was higher in the observation group than in the control group ( $P<0.05$ ) . In the observation group, 9 neonates were transferred to NICU: 4 neonates with low oxygen saturation and 5 neonates with tachypnea, all of them had a good prognosis and were discharged from the hospital within 1 week. Therefore, although prolonged labor leads to amniotic fluid contamination and increased incidence of fetal distress, it does not affect perinatal prognosis and outcome, which is consistent with the findings of previous studies [6, 12-17].

In conclusion, the present study showed that under the new labor management model, the increase in the duration of labor increased the incidence of maternal fever, amniotic fluid contamination, perineal excision, vaginal assisted delivery, cervical laceration, fetal distress, and neonatal transfer to the NICU, while there was no statistically significant difference in the incidence of post-partum hemorrhage, manual removal of placenta, and neonatal asphyxia, which suggests that the obstetrician-gynecologists should not use a new model when the duration of labor is  $>24$  hours. This suggests that obstetricians and gynecologists, under the new labor management model, should closely observe the progress of labor when it is  $>24$  h, strengthen the intervention, actively promote the labor process, provide symptomatic treatment, ensure the mental and psychological state of pregnant women, and make good preparations for assisted delivery and neonatal resuscitation, so as to reduce the occurrence of the adverse outcomes of mothers and infants.

**Authors' contributions:** Lu Yihan proposed the main research objectives, was responsible for the conception and design of the study, the implementation of the study, and the writing of the paper; Wang Guiwen and Sun Yue

were responsible for the drawing and presentation of the table; Feng Leunrun, Han Yufei, and Song Zhenzhen were responsible for the collection and organization of data and the statistical analysis of the data; Sun Ying and Dai Huihua conducted the revision of the paper; and Chen Sheng was responsible for the quality control and the review of the article and the supervision and management of the article as a whole, and the overall supervision and management.

There is no conflict of interest in this paper.

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